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HIGH RESOLUTION SONOGRAPHY IN THE EVALUATION OF PAINFUL WRIST

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ABSTRACT

Background: Wrist pain is a common clinical complain. Nontraumaticwrist pain common causes are focal cystic, Solid mass,Tenosynovitis,Carpal tunnel syndrome, arthritis and vascular changes. Musculoskeletal ultrasound is a rapid and easy method of achieving diagnostic information with low patient discomfort.

Materials and Methods: This prospective study was conducted on 100 patients complaining of nontraumaticwrist pain.This study conducted in Department of Radio diagnosis G.R. Medical College and J.A.H Gwaliorin close association with Department of orthopedics. All patients were examined by x-ray radiography and High resolution ultrasonography.

Result: In 100 patients ultrasoundrevealed an abnormality in 93/100 cases of painful wrist.In ultrasonography Ganglion cyst was the commonest nontraumatic lesion found in 33 patients (33%). other pathology include tenosynovitis, dequervain tenosynovitis,solid mass, Rheumatoid arthritis, Vascular malformation and Tendon tear.

Conclusion: Ultrasound is an important imaging modality for evaluation of wrist pain and is able to identify abnormality inhigh percentage of cases.

INTRODUCTION:

Musculoskeletal ultrasonography (USG) of the hands and wrist recently has been increasing in esteem. Rapid technical advances in the USG, such as new ultra-high frequency probes and smaller probe sizes, have led to improved image quality[1]. Wrist pain is common condition with various causes.The ideal initial imaging device, after plain radiograph is ultrasound because it provides economical and non invasive imaging of tissue. High frequency Ultrasound is useful in differential diagnosis of a variety of local and systemic causes of the pain. This, in turn, has accelerated the growth of musculoskeletal USG. Superficial structures of the hands and wrist, including the tendons, ligaments, nerves are amenable to imaging with high frequency USG.[1]

Sonography is an excellent modality for investigating many structures of the hand and wrist. It is best used when the problem is well localized and when the clinical question is relatively specific.[2]

Ultrasonography can demonstrate the intrinsic changes affecting the median nerve including its cross section area and also demonstrate the extrinsic abnormalities at the carpal tunnel .[3]

AIMS AND OBJECTIVES:

- To evaluate anatomyand sonographic examine of wrist joint pain patient .
- To describe typical sonographic appearance of lesion in wrist pain patient and detect different pathologies.

MATERIALS AND METHODS:

The study was conducted in the Department of Radiodiagnosis, G.R.M.C.,Gwaliorin February2018 to August2019. A total of 100 patients within 18-70 years of age having history of non-traumatic painful wrist were included in the study.A pre-informed written consent is taken from the patient, which is attached to a questionnaire which include the patient's history, general physical examination and detailed wrist joint examination such as durationof wrist pain, swelling, number of joints involved and limitedwrist movement was noted in all the patients. Relevant laboratory findings (RA factor, nerve conduction velocity test, ESR) were recorded. An Antero Posterior and lateral x-ray of the affected wrist joint was taken. This was followed by ultrasound examination of affected wrist.

METHOD-

Ultrasound examination of affected wrist done by alokaprosound alpha 6 ultrasound imaging system using 10 MHZ high frequency linear transducersprobe was used. High resolution ultrasonography was performed on a Dorsal aspect was evaluated first followed by the palmar aspect. Contralateral wrist was also examinedconfirmatory diagnosis based on clinical, lab findings, Histopathology, MRI imaging, operative history and follow-up.

How we evaluate?

We begin scanning the wrist from its extensor aspect. Two important USG anatomy landmark, namely the extensor retinaculum and theLister tubercle .The extensor retinaculum havenumerous deep attachments, which divide the extensor aspect into six distinctcompartments. The abductor pollicislongus and the extensor pollicisbrevis tendons lie in first compartment. The extensor carpiradialislongus and extensor carpi radialisbrevis tendons located in the second compartment. The third compartment has the extensorpollicislongus tendon. The fourth compartment contains four tendons of the extensor digitorum as well as the extensor indicis tendon.The extensor digitiminimi placed in the fifth compartment, while the sixth compartment has the extensor carpi ulnaris.

The important anatomic structure on the flexor surface is the flexor retinaculum. This strong fibrous band crosses the anterior of the carpus and converts its anterior concavity into the carpal tunnel, through which pass the flexor tendons and the median nerve. Theflexor pollicislongus tendon permits through the radial side of the tunnel. The superficialis tendon is superficial to the profundus tendon inthe palm, until it splits at the level of the proximal third of the proximal phalanx. The profundus tendon passesthrough the divided superficialis tendon and inserts at the base of the distal phalanx[4].

Pathologies -

Ganglion cyst USG reveals as anechoic lesions with thin margins . A small anechoic communicating duct may be seen extending from the ganglion to the articular space.[5]

Tenosynovitis is an inflammation of the tendon sheath and USGreveals fluid in the tendon sheath and an anechoic halo around the tendon on transverse images .Hypoechoic synovial sheath thickening seen in chronictenosynovitis.[6]

De Quervain's tenosynovitis affect the tendons of the abductor pollicislongus and extensor pollicisbrevis. The affected tendons gettrapped within the fibroosseus canal. USG shows hypoechoic thickening of the surrounding tendon sheath.[7]

Rheumatoid arthiritis may be demonstrated effectively by USG. The pannus involving the tendon sheath is markedly hypoechoic andshows markhypervascularity on color Doppler.[8]

USG can differentiate between complete andincomplete tears. It has a role in diagnosing, staging, and locating the tear. the gapbetween the fragments may be filled with hemorrhagic fluid or granulation tissue. Longitudinal scans the discontinuity of the fibrillarpattern and the gap between the torn fragments can be measured . The tendon may not be visualized at all if the tornfragments are widelyseparated. Thus late-stage tendon become ruptures.[4]

Carpal tunnel syndrome due to compression of the median nerve at the wrist. On USG, there is aalteration in theshape and echotexture of the nerve. The nerve shows an abnormal bulge proximal to the carpal tunnel with an abrupt caliber change at theentrance to the tunnel. This is referred to as the 'notch' sign. The nerve appears swollen at the proximal aspect of thetunnel and flattened at the distal aspect. A cross-sectional area of > 10 mm 2 of the median nerve, is considered diagnostic at the proximaltunnel level.[9]

Giant cell tumors On USG appear as hypoechoic masses,sometimes with lobulated contours.[5]

Vascular malformation USG image showing a predominantly hypoechoic lesion with variable low level internal echoes.Color Doppler image showing peripheral vascularity in the lesion. On compression proximal to the lesion and on sudden release, there is vascularity seen. The features suggestive of vascular malformation.[11]

RESULTS:

In our study,In 100 patients there were 49 male patients and 51 female patients; their ages ranged between 18 and 70 years (mean age, 31 years). Maximum age was 67 years. Minimum age was 21 years. The most affected age group was between 51-65 years (46%). All patients underwent X-ray and it could made diagnosis only in 12 patients. all patients showed painful wrist (100%) .82/100 (82.0 %) had pain of more than 3 months duration and other symptoms such as limitation of movement (31%), swellings (58%), and tingling and numbness (16%), while motor symptoms (weakness of hand muscles) were present in 11 (11 %) patients. This findings noted were in concordance with study by **VanVugt *et al.*** patients with wrist pain during activity represented 24%, paresthesia 14%, burning pain at rest 29%, and swellings 57%.Ganglion cyst was the most common lesion, found in (33%) patients.[12]

Table 1 :Distribution of final diagnosis and USG diagnosis in wrist pain pathologies(%)

Wrist pain pathologies	USG diagnosis		Final diagnosis (Based on clinical, MRI imaging, operative, Histopathology, rheumatoid factor, nerve conduction velocity test and follow-up)	
Ganglion cyst	32	32%	33	33%
Tenosynovitis	32	32%	31	31%
Solid mass	06	06%	06	06%
Carpal tunnel syndrome	09	09%	12	12%
Rheumatoid arthritis	10	10%	13	13%
Tendon tear	02	02%	03	03%
Vascular malformation	02	02%	02	02%
No abnormalities seen	07	07%	-	-
Total	**100**	**100**	**100**	**100**

DISCUSSION:

Ultrasound of wrist revealed a wide spectrum of finding in our study group.Among the 100 patients ultrasound abnormality wasfound in 93 i.e. 93% patients. The most common pathology notedon ultrasound was the presence of cystic/solid soft tissue masses,noted in 39/100 i.e. 39 % of patients. 33 of these 39 (84.21%)patients had ganglion cyst and while 6 (15.38 %)were solid .out of which 2 (5.12 %) had giant cell tumor , 1(2.56%) had neurofibroma,3 (7.69 %) had lipoma. This findings noted were in concordance with **Bianchi S.** et al in **2008** to present thesonographic appearance of the most common masses of the wristand hand and to discuss the role of sonography in their diagnosisstated Ganglia are the most common masse of the wrist and hand. When the location and sonographic appearance of theganglia was analyzed, the following facts emerged in our study.[5]

22/33 (66.67 %) ganglion cysts were seen on dorsal aspect while 11/33(33.33 %) were seen on volar aspect. Most of the ganglion cysts i.e. 25/33 (75.75%) showed presence of internal septae/ echoes. 22/33(66.66 %) of the ganglion cysts had well defined margins while joint communication was visualized in 14/33 i.e. (42.42)% patients having ganglion cyst.03 /33 (9.09)of the ganglia in our study showed vascularity.

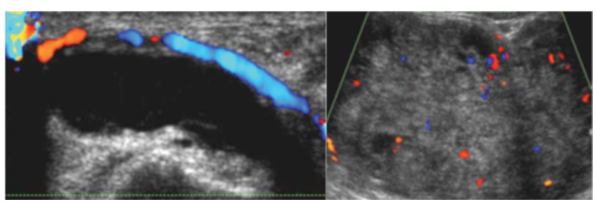

Figure 1 (A, B): (A)Longitudinal US image with Color Doppler showing a well definedanechoiccystic lesion and surrounding the radial artery.(B)Longitudinal US image Nerve sheath tumour- Neurofibroma. showing a lobulated heterogenous soft tissue mass lesion with few areas of cystic degeneration.

The findings noted were in accordance with a study by **Angelides AC.** et al in which they found that most of ganglion

cyst were dorsal aspect.[13]Some findings are in accordance with a study by **WangG.** et al inwhich they found that 35 % showed jointcommunications, 65% showed well defined vascularity within.[14] Inthe present study **Tenosynovitis** was noted in 31 /100 (31%) of thepatients. This is in agreement with the prospective study done by**Van vugt RM** et al in which theyfound 25% patients were having tenosynovitis/ tendinitis as themain pathology in patients of wrist painand 1 case had deQuervain's tenosynovitis.[12]

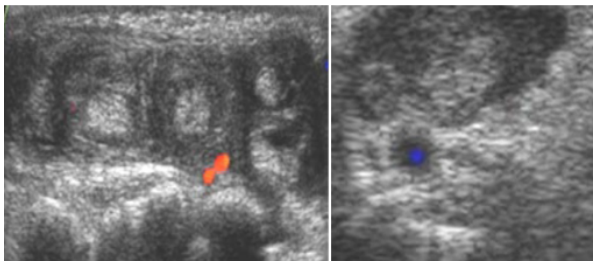

Figure 2 ExtensorTenosynovitis and De Quervain's disease (A and B):. image showing tendon sheath thickening and hypoechoic tendon sheath collection with increased vascularity.

06 /100 (06 %) patients in our study group were finally diagnosed to have **DeQuervain'stenosynovitis,** presented with pain over the radial side of wristand showed presence of thickening of the synovial sheath withanechoic fluid surrounding the tendons of first extensorcompartment. Mild internal vascularity was also noted within thethickened tendon sheath. **(Fig 2 B)** The findings noted were agreementwith **Giovagnorio F** et al who performed highresolutionultrasonography of the wrists in eight patients with deQuervain disease; and found changes of the tendon sheath in allcases of de Quervain disease in from of thickening and edema ofthe synovial sheath and fluid within the sheath.[15]

12/100 (12 %) patients in our study group were finally diagnosed to have **carpal tunnel syndrome** In all 12 patients withclinical suspicion of carpal tunnel syndrome and abnormal nerveconduction velocity test, swelling of the median nerve at carpal tunnel with a cross sectional area of >10 mm was seen. All thepatients also showed increased wrist forearm ratio of crosssectional area of median nerve.**(Fig 3 A and B)** Our findings are inclose associationwith **Ziswiler HR** who foundthat the maximum cross sectional area of median nerve in carpaltunnel increases in patients with carpal tunnel syndrome and therewas a high concordance between sonography and nerve conduction study .[16] Meanwhile, **Sernik et al**considered a cutoff point 10mm more accurate for diagnosing CTS .[9]

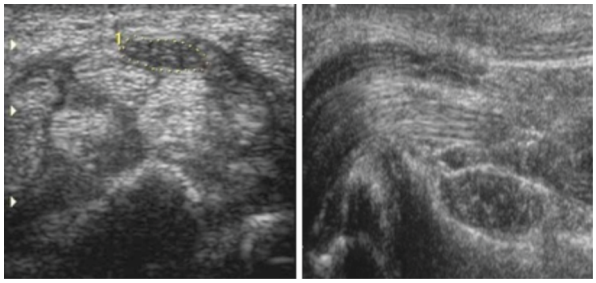

Figure 3 (A and B): Transverse and Longitudinal scans show median nerve incarpal tunnel (A) and 12 mm proximal to wrist (B). There isincrease in cross sectional area of median nerve in carpaltunnel with increased wrist to forearm ratio.

In the present study **Tendon tear** was noted in 03/100 (03 %) .Thus HRUSG giving sensitivity and specificity of 66.67 % and 100% respectively.Our result is similar to **Wang et al.** who used ultrasonic assistance in the diagnosis of flexor tendon injuries and showed that USG was used to make correct preoperative determinations in six of the eight patients they studied.[17]

In the present study**Rheumatoid arthritis**was noted in 13/100 (13 %) of the patients.In which 9 patients rheumatoid arthritiswere identified by HRUSG wrist . which can progress to bone erosions, tendon rupture, joint destruction, and deformity**.** On MRI and other investigations that 4 patients found to have rheumatoid arthritis. Thus HRUSG giving sensitivity, specificity and accuracy of 69.23% ,98.85 and 95.00 % respectively.The findings are in accordance with a study by**McNally EGet al**.[18]

In the present study**Vascularmalformation** was noted in 02/100 (02 %) of the patients.[13]Plain radiographs showphleboliths, which were calcific densitieswithin the thrombosed veins of the malformation . ultrasonography diagnoselarger malformations. Color Dopplerdemonstrates a mass that is heterogeneous, monophasic, hypoechoic, andcompressible. On MRI assess the extent of the vascular malformation andits relationship to other adjacentstructures. T1-weightedimages wasisointense, whereas T2-weighted images washyperintense. Confirmatory diagnosis made by Magnetic resonance angiography.[11]

Table 2 :Disease specific sensitivity and specificity of pathologies causing wrist pain in HRUSG

Diagnosis	Sensitivity	Specificity	PPV	NPV	Accuracy
Ganglion cyst	93.44%	98.51%	96.88%	97.06%	97.00%
Tenosynovitis	93.55%	95.65%	90.63%	97.06%	95.00%
Solid mass	83.33%	98.94%	83.33%	98.94%	98.00%
Carpal tunnel syndrome	75.00%	100.00%	100.00%	96.70%	97.00%
Rheumatoid arthritis	69.23%	98.85%	90.00%	95.56%	95.00%
Tendon tear	66.67%	100.00%	100.00%	98.98%	99.00%
Vascular malformation	100.00%	100.00%	100.00%	100.00%	100.00%

CONCLUSION:

Hence we conclude that ultrasoundhas become the preferred modality for imaging patients for evaluation of wrist pain and is able to detect abnormality inhigh percentage of cases. US imaging is operator dependent, lack ionizing radiation and cost effective, non invasive, portable,easily accessible and comparison with the opposite side can be readily done. High resolution USG high sensitivity, specific and accurate in the assessment of focal cystic mass and tendon pathologies. The drawback for USG is that it is operator dependant USG anatomical knowledge and practice is a must and awareness of the artefacts of this procedure. Ultrasound helps early detectionof pathology, before radiographic abnormality become apparentespecially the soft tissue lesions.

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